

# The role of $f_0(1710)$ in the $\phi\omega$ threshold peak of $J/\Psi \rightarrow \gamma\phi\omega$

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(Dated: October 25, 2012)

## Abstract

We study the process  $J/\Psi \rightarrow \gamma\phi\omega$ , measured by the BES experiment, where a neat peak close to the  $\phi\omega$  threshold is observed and is associated to a scalar meson resonance around 1800 MeV. We make the observation that a scalar resonance coupling to  $\phi\omega$  unavoidably couples strongly to  $K\bar{K}$ , but no trace of a peak is seen in the  $K\bar{K}$  spectrum of the  $J/\Psi \rightarrow \gamma K\bar{K}$ . This, reinforced by the negative results from a devoted Belle experiment in a related reaction, serves us to rule out the interpretation of the observed peak as a signal of a new resonance. After this is done, a thorough study is done on the production of a pair of vector mesons and how its unavoidable interaction leads necessarily to a peak in the  $J/\Psi \rightarrow \gamma\phi\omega$  reaction close to the  $\phi\omega$  threshold, due to the dynamical generation of the  $f_0(1710)$  resonance by the vector-vector interaction. We then show that both the shape obtained for the  $\phi\omega$  mass distribution, as well as the strength are naturally reproduced by this mechanism.

## I. INTRODUCTION

A BES experiment looking for the decay of  $J/\Psi \rightarrow \gamma\phi\omega$  [1] observed a neat peak close to the  $\phi\omega$  threshold which was tentatively associated to a  $J^{PC} = 0^{++}$  state with mass around 1812 MeV and width of about 105 MeV. An experiment with ten times more statistics has been reported recently [2] and the peak is reconfirmed, the reanalysis leading to claims of a state with mass  $M = 1795 \pm 7_{-5}^{+23}$  MeV and a width  $\Gamma = 95 \pm 10_{-34}^{+78}$  MeV, where the first error is statistical and the second systematic. They also report a product of branching ratios  $B(J/\Psi \rightarrow \gamma R) \times B(R \rightarrow \omega\phi) = (2.00 \pm 0.08_{-1.00}^{+1.38}) \times 10^{-4}$ . The decay of  $J/\Psi \rightarrow \gamma\phi\omega$  is doubly OZI suppressed with a production rate that is suppressed by at least one order of magnitude with respect to  $J/\Psi \rightarrow \gamma\omega\omega$  and  $J/\Psi \rightarrow \gamma\phi\phi$  [3].

As usual, any new claim of a state is followed by theoretical suggestions for its interpretation, and in this case there have been works offering possible interpretations as a tetraquark state [4], a hybrid [5], a glueball state [6], a threshold cusp attracting a resonance [7] and an effect due to intermediate meson rescattering [8]. So far, none of these interpretations has been ruled out or supported by the experiment.

In the present work we propose a different interpretation as due to the production of the  $f_0(1710)$  resonance below the  $\phi\omega$  threshold. We shall show that the presence of this resonance necessarily leads to a peak around the  $\phi\omega$  threshold with a shape and strength compatible with experiment. Invoking the principle that if one phenomenon can be explained by an already established fact one should not make claims of new physics, we will conclude that the observed peak is not a signal of a new resonance but a replica of the  $f_0(1710)$ . This conclusion gets extra support from failed searches of the Belle collaboration in the  $B^\pm \rightarrow K^\pm\omega\phi$  reaction [9]. Moreover, a very strong argument against this peak being a new state is provided by the fact that both the  $\omega$  and the  $\phi$  couple strongly to  $K\bar{K}$ . In this case the  $\omega$  and  $\phi$  can emit both a  $K\bar{K}$  pair and one of the  $K$  can be exchanged virtually between the two vectors, leading to a decay of the  $0^{++}$  state into  $K\bar{K}$  with  $L = 0$ . In this channel the resonance would be very far from threshold and the peak should show up neat, with no ambiguities about its interpretation. Yet, in the experiment studying  $J/\Psi$  decay into  $\gamma K\bar{K}$ , clear peaks are seen for the  $f_0(1500)$  and  $f_0(1710)$  but no trace is seen of any peak around 1800 MeV [10].

Among the theoretical papers mentioned, Ref. [8] deserves a special mention since the idea is also that the peak observed could be a replica of the  $f_0(1710)$  resonance, as we state here. The idea in Ref. [8] is that the  $J/\Psi$  decays into  $\gamma f_0(1710)$ , then the  $f_0(1710)$  resonance couples to a pair of mesons (vectors mesons, particularly  $K^*\bar{K}^*$ , were shown to be dominant) and there is rescattering of these vector mesons to produce the  $\phi\omega$  final state. An enhancement close to the  $\phi\omega$  threshold was produced with this mechanism, with a strength much smaller than the experimental data, and no firm conclusions were drawn. Yet, as the authors mentioned, there were many unknowns in the model, particularly tied to the interaction of vector mesons ( $V$ ), where a perturbative approach was followed, assuming  $VV \rightarrow \phi\omega$  transition mediated by  $K$  and  $\kappa$  exchange. An important step forward in this direction was given later on in Refs. [11, 12], with a thorough study of the vector-vector interaction within a coupled channels unitary approach with the dynamics extracted from the local hidden gauge Lagrangians [13–15]. This study allowed to see that the vector-vector scattering matrices develop some poles as a consequence of the interaction, and resonances are generated. These resonant states qualify as molecular states of two vector mesons and are usually referred to as dynamically generated resonances. Among many of them, the

$f_0(1710)$  is generated and couples strongly to  $K^*\bar{K}^*$  and  $\phi\omega$ . In such a case, the mechanism for final  $\phi\omega$  production proceeds with a primary production of  $\gamma VV$  followed by rescattering of these vectors to produce  $\phi\omega$  in the final state. As we shall see, the primary production of  $\phi\omega$  is not allowed and only the  $VV$  rescattering leads to the  $\phi\omega$  in the final state. One could reinterpret the doubly OZI suppressed mechanism for  $\omega\phi$  production in this way, the first suppression applying to the production of all  $VV$  pairs without charm. This particular feature actually works in favor of having a more neat resonant shape since the  $\phi\omega$  comes only from rescattering of the vector mesons by means of an amplitude that incorporates the  $f_0(1710)$  resonance. Thus, a background from uncorrelated  $\phi\omega$  production is essentially absent in the mechanism of production and the effects of the  $f_0(1710)$  show up more neatly. Since the resonance is below the  $\phi\omega$  threshold, it is a combination of the tail of this resonance and the increasing phase space for  $\phi\omega$  production that produces the visible peak. An enhancement of the strength near threshold due to resonances below threshold is unavoidable and this is a well known effect. Sometimes this shows up only as a deviation from phase space, with no peak structure [16–18], but, depending on the strength of the background, sometimes it can also show up as a clear peak. This was the case of the  $e^+e^- \rightarrow J/\Psi D\bar{D}$  reaction, where one peak close to the  $D\bar{D}$  threshold was observed and associated to a resonance in the Belle collaboration work of Ref. [19]. However, in Ref. [20] it was shown that a better fit to the data occurred due to the presence of a scalar hidden charm state below the  $D\bar{D}$  threshold,  $X(3700)$ , predicted in Ref. [21]. In the present case, the absence of a significant background for  $\phi\omega$  production magnifies the resonance shape close to the  $\phi\omega$  threshold, to the point that in Refs. [1, 2] a strong case was made about the discovery of a new resonance. We shall argue here that this is not the case, showing that the peak comes as an unavoidable consequence of the coupling of the  $\phi\omega$  to the  $f_0(1710)$  resonance.

## II. FORMALISM

In Ref. [22] the study of the radiative decay modes of the  $J/\Psi$  into a photon and one of the tensor mesons  $f_2(1270)$ ,  $f'_2(1525)$ , as well as the scalar ones  $f_0(1370)$  and  $f_0(1710)$ , was undertaken and a good agreement with ratios of branching ratios was obtained. We will follow closely this formalism since for our present study we need both the radiative decay of the  $J/\Psi$  into  $f_0(1710)$ , as well as the more concrete one of the  $J/\Psi \rightarrow \gamma\phi\omega$ .

As in Ref. [22], we assume, following the argumentation of Ref. [3], that the mechanism of Fig. 1a dominates the reaction. Further support for this assumption was found in Ref. [22].

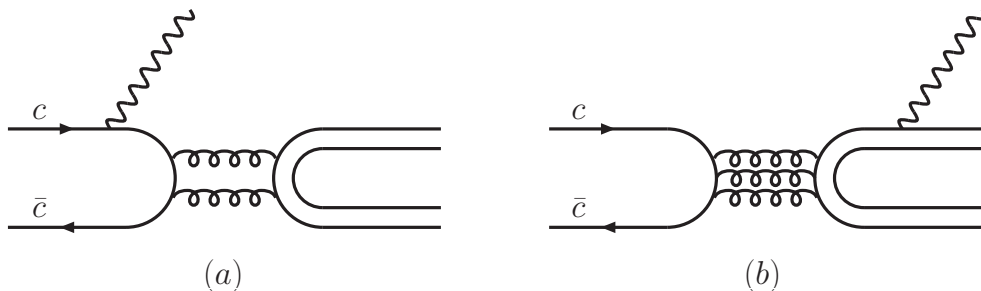


FIG. 1. Two mechanisms of the  $J/\Psi$  radiative decays.

Then, the  $c\bar{c}$  component after the  $\gamma$  radiation will decay into pairs of vectors, which inevitably will interact among themselves. This is shown diagrammatically in Fig. 2. The following

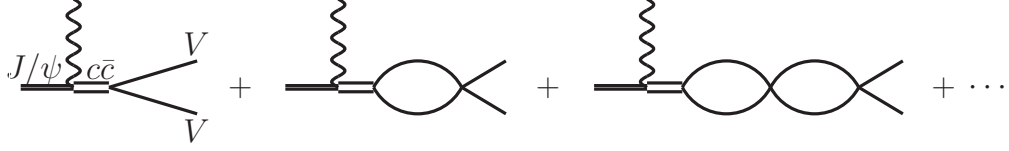


FIG. 2. Schematic representation of  $J/\Psi$  decay into a photon and one dynamically generated resonance.

step is to recall that the  $c\bar{c}$  object can be considered as an SU(3) singlet and then the pair of original vectors in the primary step will couple to an SU(3) singlet. This can be easily obtained from the trace of  $V \cdot V$

$$VV_{\text{SU(3) singlet}} = \text{Tr}[V \cdot V], \quad (1)$$

where  $V$  is the SU(3) matrix of the vector mesons

$$V = \begin{pmatrix} \frac{1}{\sqrt{2}}\rho^0 + \frac{1}{\sqrt{2}}\omega & \rho^+ & K^{*+} \\ \rho^- & -\frac{1}{\sqrt{2}}\rho^0 + \frac{1}{\sqrt{2}}\omega & K^{*0} \\ K^{*-} & \bar{K}^{*0} & \phi \end{pmatrix}. \quad (2)$$

We, thus, find the vertex

$$VV_{\text{SU(3) singlet}} = \rho^0\rho^0 + \rho^+\rho^- + \rho^-\rho^+ + \omega\omega + K^{*+}K^{*-} + K^{*0}\bar{K}^{*0} + K^{*-}K^{*+} + \bar{K}^{*0}K^{*0} + \phi\phi. \quad (3)$$

One then projects this combination of VV states, which are the building blocks of the resonance produced, into VV isospin states with unitary normalization (an extra factor  $1/\sqrt{2}$  for identical particles or symmetrized ones) and phase convention  $|\rho^+\rangle = -|1, +1\rangle$ ,  $|K^{*-}\rangle = -|1/2, -1/2\rangle$ ,

$$|\rho\rho\rangle_{I=0} = -\frac{1}{\sqrt{6}}|\rho^0\rho^0 + \rho^+\rho^- + \rho^-\rho^+\rangle, \quad (4)$$

$$|K^*\bar{K}^*\rangle_{I=0} = -\frac{1}{2\sqrt{2}}|K^{*+}K^{*-} + K^{*0}\bar{K}^{*0} + K^{*-}K^{*+} + \bar{K}^{*0}K^{*0}\rangle, \quad (5)$$

$$|\omega\omega\rangle_{I=0} = \frac{1}{\sqrt{2}}|\omega\omega\rangle, \quad (6)$$

$$|\phi\phi\rangle_{I=0} = \frac{1}{\sqrt{2}}|\phi\phi\rangle, \quad (7)$$

and one gets the weights for primary VV production of the process  $J/\Psi \rightarrow \gamma VV$  with VV pairs in  $I = 0$ :

$$w_i = \begin{cases} -\sqrt{\frac{3}{2}} & \text{for } \rho\rho \\ -\sqrt{2} & \text{for } K^*\bar{K}^* \\ \frac{1}{\sqrt{2}} & \text{for } \omega\omega \\ \frac{1}{\sqrt{2}} & \text{for } \phi\phi. \end{cases} \quad (8)$$

It is interesting to note that there is no primary production of  $\phi\omega$  with this mechanism. Production of  $\phi\omega$  will occur with the rescattering of the primary  $VV$  vectors as depicted in Fig. 2, and the sum of these terms is readily done by means of

$$t_{J/\Psi \rightarrow \gamma \phi \omega} = A \sum_{j=1}^4 w_j G_j t_{j \rightarrow \phi \omega}, \quad (9)$$

with  $A$  an unknown constant,  $w_j$  are the weights of Eq. (8) for the different primary  $VV$  channels,  $G_j$  the loop function for the intermediate  $VV$  states and  $t_{j \rightarrow \phi \omega}$  the transition scattering matrix from the intermediate  $VV$  states to  $\phi\omega$ . We take the information for the  $G_j$  and  $t_{ij}$  functions from Ref. [12].

The  $t_{i \rightarrow j}$  matrices can be traced back to the results of Ref. [12] by writing for each resonance

$$t_{i \rightarrow j} = \frac{g_i g_j}{s - M_R^2 + i M_R \Gamma_R} \quad (10)$$

where  $g_i, g_j$  are the couplings of the resonance to the  $i, j$  channels. We only need the  $f_0(1710)$  resonance here and the couplings are tabulated in Table I.

TABLE I. Couplings  $g_k$ 's appearing in Eq. (10), with  $k$  one of the coupled channels:  $\rho\rho$ ,  $K^*\bar{K}^*$ ,  $\omega\omega$ ,  $\phi\phi$ , and  $\phi\omega$ . The units of these  $g_k$ 's are MeV.

| $R$         | $\rho\rho$      | $K^*\bar{K}^*$ | $\omega\omega$ | $\phi\phi$     | $\phi\omega$  |
|-------------|-----------------|----------------|----------------|----------------|---------------|
| $f_0(1710)$ | $-1030 + i1086$ | $7124 + i96$   | $-1763 + i108$ | $-2493 - i204$ | $3010 - i210$ |

With the amplitude of Eq. (9), which depends on the invariant mass of  $\phi\omega$ , we can construct the  $\phi\omega$  mass distribution given by

$$\frac{d\Gamma}{dM_{\text{inv}}} = \frac{1}{(2\pi)^3} \frac{1}{4M_{J/\Psi}^2} p_\gamma \bar{q}_\omega |t_{J/\Psi \rightarrow \gamma \phi \omega}|^2, \quad (11)$$

where  $p_\gamma$  and  $\bar{q}_\omega$  are the photon momentum in the  $J/\Psi$  rest frame and the  $\omega$  momentum in the  $\phi\omega$  rest frame, respectively

$$p_\gamma = \frac{\lambda^{1/2}(M_{J/\Psi}^2, 0, M_{\text{inv}}^2)}{2M_{J/\Psi}}; \quad \bar{q}_\omega = \frac{\lambda^{1/2}(M_{\text{inv}}^2, m_\omega^2, m_\phi^2)}{2M_{\text{inv}}}. \quad (12)$$

On the other hand, if we are interested in the production of the  $f_0(1710)$  resonance regardless of its decay channel, the relevant mechanism is depicted diagrammatically in Fig. 3 and we have

$$t_{J/\Psi \rightarrow \gamma f_0} = A \sum_{j=1}^4 w_j G_j g_j \quad (13)$$

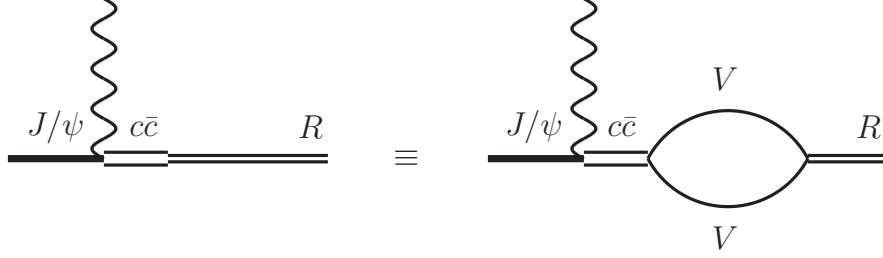


FIG. 3. Schematic representation of  $J/\Psi$  decay into a photon and a dynamically generated resonance.

and the partial decay width for this process is given by

$$\Gamma_{J/\Psi \rightarrow \gamma f_0} = \frac{1}{8\pi} \frac{1}{M_{J/\Psi}^2} |t_{J/\Psi \rightarrow \gamma f_0}|^2 q_\gamma, \quad (14)$$

where  $q_\gamma$  is the momentum of the photon, like  $p_\gamma$  of Eq. (12) but it is calculated at  $M_{\text{inv}} = M_{f_0(1710)}$ . The theory cannot provide the value of the constant  $A$  in Eqs. (9) and (13) since this requires a precise knowledge of the mechanism of OZI suppression, but if we divide  $d\Gamma/dM_{\text{inv}}$  by  $\Gamma_{J/\Psi \rightarrow \gamma f_0}$  the constant is cancelled and we can make precise predictions for the ratio. We shall call this ratio  $R_\Gamma$

$$R_\Gamma = \frac{\int dM_{\text{inv}} \frac{d\Gamma}{dM_{\text{inv}}}}{\Gamma_{J/\Psi \rightarrow \gamma f_0}}, \quad (15)$$

which we can evaluate with the tools presented before. The value of this magnitude is relevant because, together with the shape of the  $\phi\omega$  mass distribution, it can be compared with the experimental values.

Experimentally we have, from the Particle Data Group (PDG) [23],

$$B(J/\Psi \rightarrow \gamma f_0 \rightarrow \gamma K \bar{K}) = (8.5^{+1.2}_{-0.9}) \times 10^{-4} \quad (16)$$

and for  $B(f_0(1710) \rightarrow K \bar{K})$  we have some values in Ref. [23]

$$\begin{aligned} B(f_0(1710) \rightarrow K \bar{K}) &= 0.36 \pm 0.12 && \text{Ref. [24]} \\ &= 0.38^{+0.09}_{-0.19} && \text{Ref. [25]} \\ &= 0.6 && \text{Ref. [8]}. \end{aligned} \quad (17)$$

Thus, taking the value available from Ref. [8] as listed above, we obtain

$$\frac{\Gamma_{J/\Psi \rightarrow \gamma f_0}}{\Gamma_{J/\Psi}} = (1.4 \pm 0.4) \times 10^{-3}. \quad (18)$$

On the other hand, from Ref. [2] we have

$$B(J/\Psi \rightarrow \gamma R \rightarrow \gamma \omega \phi) = (2.00 \pm 0.08^{+1.38}_{-1.00}) \times 10^{-4}, \quad (19)$$

from where estimating roughly the errors we find

$$\frac{B(J/\Psi \rightarrow \gamma R \rightarrow \omega \phi)}{B(J/\Psi \rightarrow \gamma f_0)} = 0.14 \pm 0.08. \quad (20)$$

### III. RESULTS

As a first step we show the shape of the distribution  $d\Gamma/dM_{\text{inv}}$  and compare it with the updated data of the experiment [2].

In our approach, and assuming the dominance of the diagram represented by Fig. 1a, there is no tree level contribution to the  $\omega\phi$  production. However, in order to account for the strength of the distribution at large values of  $M_{\text{inv}}$ , far away from the  $f_0(1710)$  resonance, we allow for a small background, which we take as a constant amplitude for simplicity, and we replace in Eq. (9)

$$t_{J/\Psi \rightarrow \gamma\phi\omega} \longrightarrow t_{J/\Psi \rightarrow \gamma\phi\omega} + \beta, \quad (21)$$

with  $\beta$  being a constant whose value is fixed by fitting the data around  $M_{\text{inv}} \simeq 3000$  MeV where the  $f_0(1710)$  gives no relevant contribution.

In Fig. 4 we show the distribution obtained, fixing the total strength such as to reproduce the peak of the experimental distribution of the number of  $\phi\omega$  events per bin. As we can

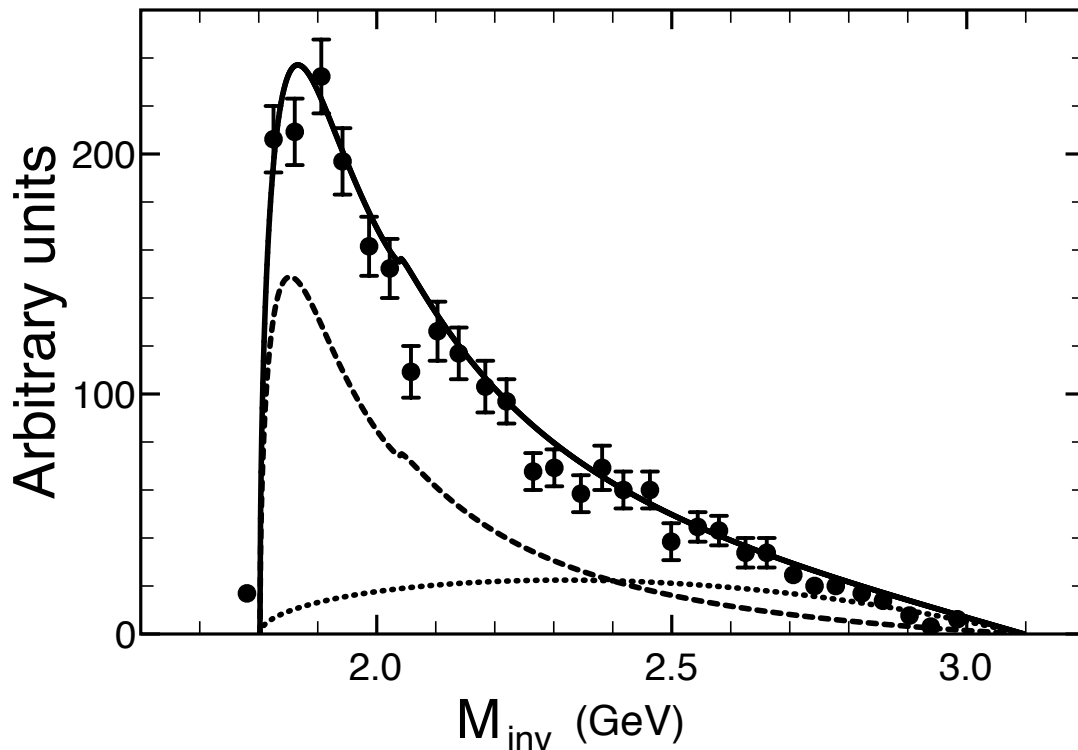


FIG. 4. The invariant mass distribution  $\frac{d\Gamma}{dM_{\text{inv}}}$  for the process  $J/\Psi \rightarrow \gamma\phi\omega$  from Eq. (11). The data points, shown by filled circles, have been taken from Ref. [2]. The dotted and dashed lines represent the background and the  $f_0(1710)$  resonance contribution, respectively. The solid line shows the coherent sum of the two.

see, there is a perfect agreement between our results and the experimental data. This might be surprising at a first sight, but the tail of the resonant shape of the amplitude of Eq. (9), together with the phase space factors in Eq. (11), essentially the factor  $\bar{q}_\omega$  which vanishes at the  $\phi\omega$  threshold, combine to give a peak close to the threshold. The resulting strength and shape of the peak are linked to the dynamics of the process.

It is interesting to separate the contribution of the resonance and the background. In Fig. 4 we also show the contribution of the resonance alone, eliminating the background  $\beta$  in Eq. (21). As we can see, the resonance term is dominant, although the interference with the background raises the strength of the distribution. For comparison we also show in the figure what one obtains from the background alone.

The agreement with the data is certainly a point to support the idea expressed in this paper. This agreement is better than the one that would be obtained by the resonance proposed in Ref. [2]. To show this, we simply substitute  $t_{J/\Psi \rightarrow \gamma \phi \omega}$  of Eq. (9) by

$$t_{J/\Psi \rightarrow \gamma \phi \omega} \rightarrow t_{\text{Emp}} = \frac{A'}{s - M_{R'}^2 + iM_{R'}\Gamma_{R'}} + \beta' \quad (22)$$

with  $A'$  adjusted to get the strength at the peak position and  $\beta'$  again adjusted to get the strength of the distribution at large values of  $M_{\text{inv}}$ . After adjusting to the total strength of the peak we obtain the distribution shown in Fig. 5, which does not reproduce well the data. It should be noted that in Ref. [2] a large range of mass and width of the resonance

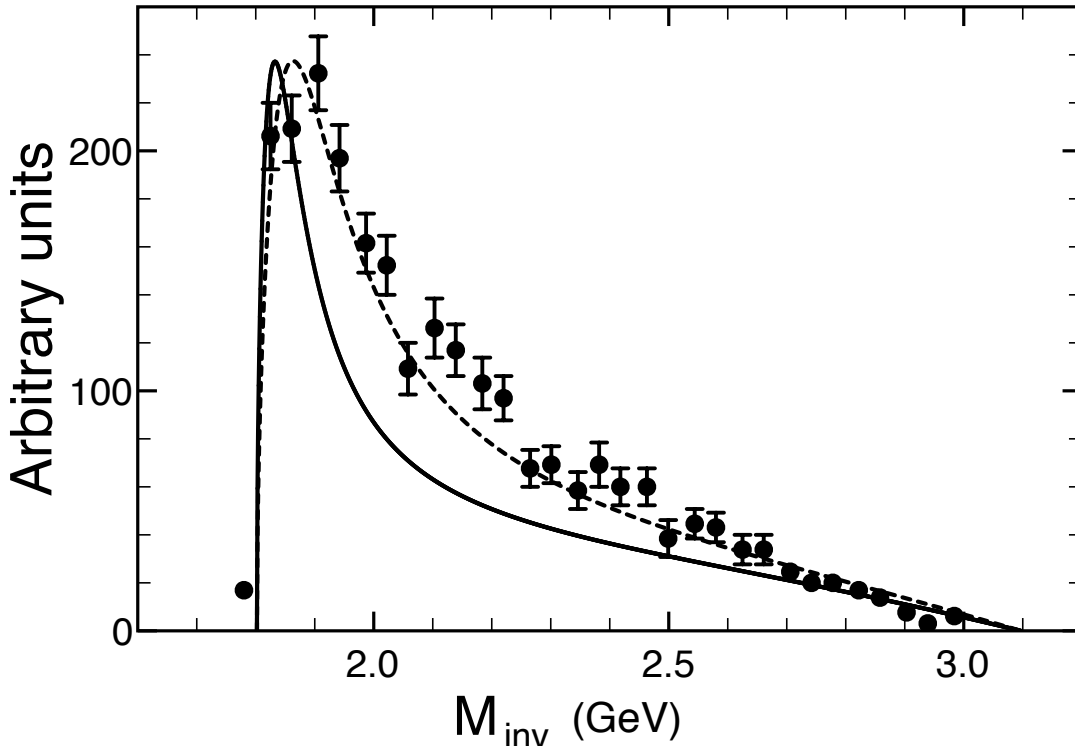


FIG. 5. The invariant mass distribution  $\frac{d\Gamma}{dM_{\text{inv}}}$  for the empirical amplitude of Eq. (22). The solid line corresponds to the results found with a Breit-Wigner form with the central values of the resonance parameters suggested in Ref. [2], i.e., mass of 1795 MeV and width of 95 MeV. The dashed curve corresponds to assuming the same mass but the upper limit of the width, 183 MeV.

are given and we find that the values of  $\Gamma_{R'}$  in the higher part of the range the agreement is better, yet of lower quality than the one provided by our approach. The important point is that once a new resonance is ruled out by the arguments in the introduction, the peak of



Ref. [2] is nicely reproduced in terms of the  $f_0(1710)$  dynamically generated in the approach of Ref. [12], independently that good fits could be obtained assuming a new resonance.

The work would not be completed if we did not calculate the strength of the  $J/\Psi \rightarrow \gamma\phi\omega$  distribution. We do it now by evaluating the ratio of Eq. (15) for the integrated  $d\Gamma/dM_{\text{inv}}$  and  $\Gamma_{J/\Psi \rightarrow \gamma f_0(1710)}$ . If we integrate up to  $M_{\text{inv}}^{\text{max}} = 2.1$  GeV, a region that accounts for the largest part of the peak, we obtain a value of  $R_\Gamma = 0.15$ , in agreement with the central experimental value of Eq. (20). We can also quantize the theoretical uncertainties. First, we take the limit of integration to  $M_{\text{inv}}^{\text{max}} = 2.3$  GeV, certainly an upper limit, and we get  $R_\Gamma = 0.21$ . Further theoretical uncertainties can be obtained by changing randomly the mass and width of the  $f_0(1710)$  between the range of the PDG,  $1720 \pm 6$  MeV and  $135 \pm 8$  MeV, respectively, and the couplings  $g_i$  by 10 %. The ratio of 0.15 gets then converted into  $R_\Gamma = 0.15 \pm 0.04$ , which added to the uncertainties in the choice of  $M_{\text{inv}}^{\text{max}}$  can be set into  $R_\Gamma = 0.15 \pm 0.06$ .

As we can see, the range of theoretical values fully overlaps with the experimental one of Eq. (20). This agreement is totally tied to the dynamics of the  $VV$  interaction that we have used, and, in as much as this dynamics has been tested in so many processes [22, 26–28], it stands on solid grounds. Then, the agreement on the absolute values of the rate of production relative to  $\Gamma_{J/\Psi \rightarrow \gamma f_0(1710)}$  is a strong point in favor of the idea exposed here that the peak observed in Refs. [1] and [2] is due to the excitation of the  $f_0(1710)$  resonance and its further decay into  $\omega\phi$ .

We have stressed the relevance of not having the  $\phi\omega$  primary production to produce the shape of the experimental distribution. In order to further understand this point we have evaluated  $\frac{d\Gamma}{dM_{\text{inv}}}$  for  $K^*\bar{K}^*$  production where one has now a tree level contribution. The second member of Eq. (9) would now be substituted by  $A(\omega_{K^*\bar{K}^*} + \sum_{j=1}^4 \omega_j G_j t_{j \rightarrow K^*\bar{K}^*})$  and  $\bar{q}_\omega$  in Eq. (11) by  $\bar{q}_{K^*}$ . In this case we observe that the background of the tree level largely dominates the distribution and only a very small peak at threshold appears that could be missed in an experiment with low resolution.

## IV. CONCLUSIONS

In this work we had a look at the data of two BES experiments for the reaction  $J/\Psi \rightarrow \gamma\phi\omega$ , where a neat peak is observed in the  $\phi\omega$  mass distribution close to the  $\phi\omega$  threshold. In the experimental works this peak was seen as a signal of one new scalar meson state with mass around 1800 MeV, not reported in the PDG. We made the important observation that both  $\phi$  and  $\omega$  couple strongly to  $K\bar{K}$  (with the same strength) and a scalar resonance coupling to  $\phi\omega$  unavoidably would couple to  $K\bar{K}$ , and it should be seen cleanly in the  $K\bar{K}$  spectrum. The fact that no trace of a peak was seen in the experiment around this energy in the  $J/\Psi \rightarrow \gamma K\bar{K}$  reaction was proof enough to rule out the peak observed in  $J/\Psi \rightarrow \gamma\phi\omega$  as a signal for a new state. Certainly the fact that other devoted reactions have failed to see that peak, as in the Belle experiment in the  $B^\pm \rightarrow K^\pm \omega\phi$  reaction [9], give extra support to the former argument.

The main part of the work has then been devoted to show that the peak observed in the experiment is naturally obtained from the excitation of the  $f_0(1710)$  resonance and its coupling to  $\phi\omega$ . The agreement of the  $\phi\omega$  distribution with experiment was excellent and the absolute rates for the partial decay width of  $J/\Psi \rightarrow \gamma\phi\omega$  reaction were also in very good agreement with experiment. The combination of all these facts clarifies the situation around this experiment with the conclusion that the peak observed is not a signal of a new

resonance, but just a replica of the well established  $f_0(1710)$  state.

## ACKNOWLEDGMENTS

This work is partly supported by DGICYT contract numbers FIS2011-28853-C02-01, FIS2011-24154, the Generalitat Valenciana in the program Prometeo, 2009/090. We acknowledge the support of the European Community-Research Infrastructure Integrating Activity Study of Strongly Interacting Matter (acronym HadronPhysics3, Grant Agreement n. 283286) under the Seventh Framework Programme of EU. The authors would like to thank the Brazilian funding agencies FAPESP and CNPq for the financial support.

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